30th Environmental and Energy Symposium

5-8 April2004

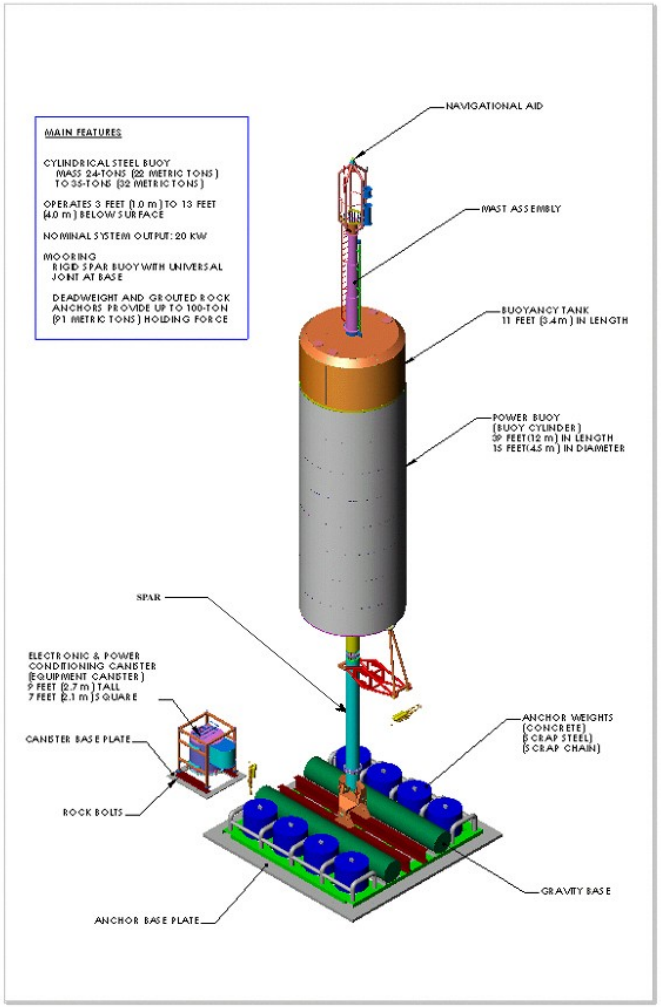
NAVFAC
Naval Facilities Engineering Command
ENGINEERING SERVICE CENTER

Wave Energy Technology Project

Elizabeth Meyer
NFESC -- CODE 427
(805) 982-1635
elizabeth.meyer@navy.mil

Overview

- Project Team
- Potential of Wave Energy in Hawaii
- Benefits of Wave Power
- PowerBuoy™ Description
- WET Program Objectives
- Environmental Advantages
- Environmental Documentation Requirements
- Program Status


MAIN FEATURES
CYLINDRICAL STEEL BUOY
MASS 24-TONS (22 METRIC TONS)
TO 35-TONS (32 METRIC TONS)
OPERATES 3 FEET (1.0 m) TO 13 FEET (4.0 m) BELOW SURFACE
NOMINAL SYSTEM OUTPUT: 20 KW
MOORING
RIGID SPAR BUOY WITH UNIVERSAL JOINT AT BASE
DEADWEIGHT AND GROUTED ROCK ANCHORS PROVIDE UP TO 100-TON (91 METRIC TONS) HOLDING FORCE
NAVIGATIONAL AID
MAST ASSEMBLY
BUOYANCY TANK
11 FEET (3.4m) IN LENGTH
POWER BUOY
(BUOY CYLINDER)
39 FEET(12 m) IN LENGTH
15 FEET(4.5 m) IN DIAMETER
SPAR
ELECTRONIC & POWER CONDITIONING CANISTER (EQUIPMENT CANISTER)
9 FEET (2.7 m) TALL
7 FEET (2.1 m) SQUARE
CANISTER BASE PLATE
ROCK BOLTS
ANCHOR BASE PLATE
ANCHOR WEIGHTS (CONCRETE)
(STEEL)
(CHAIN)
GRAVITY BASE

Major WET Components

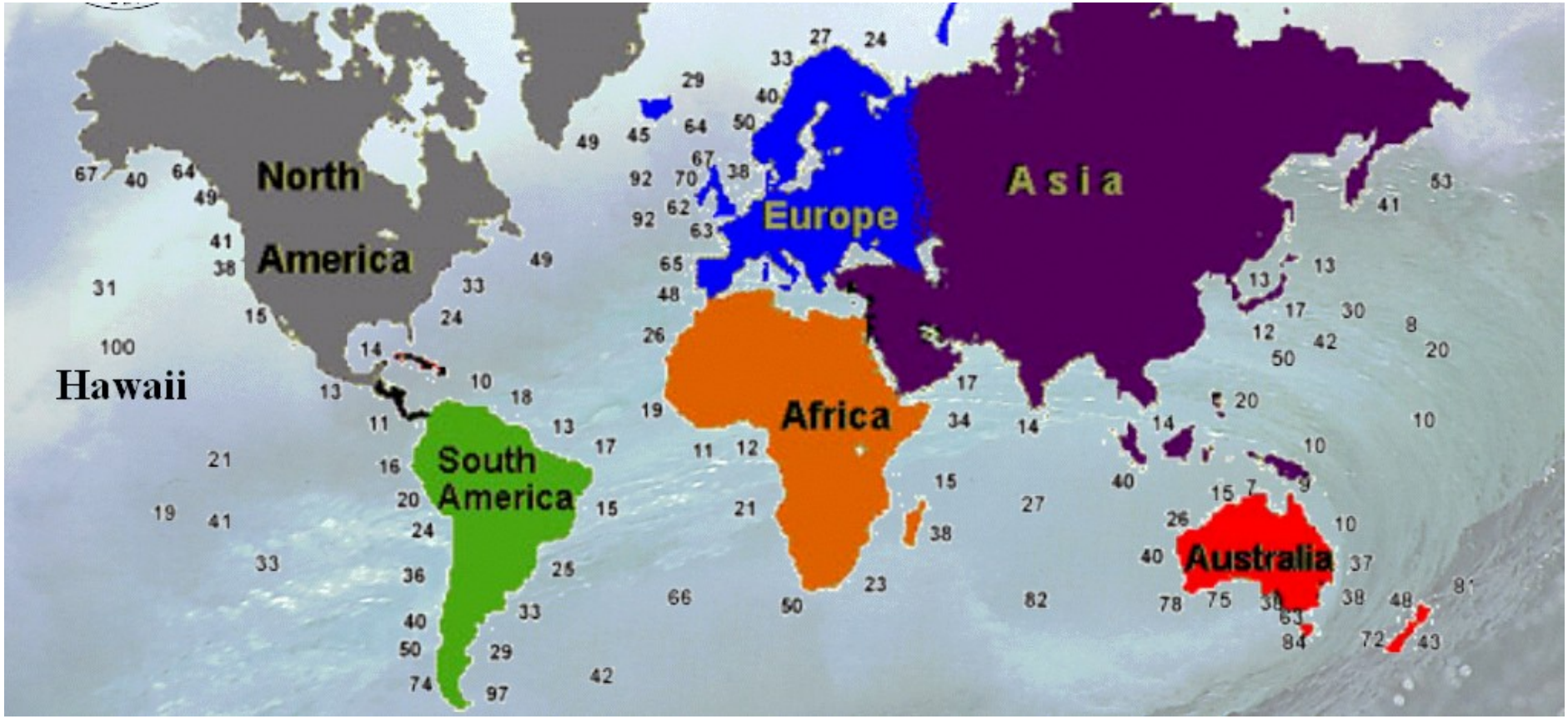
Project Team

- **Office of Naval Research (ONR)** – Sponsor, Program Manager
- **NFESC** – Project Coordination, Contract Mngt, Environmental Review, Technical QA
- **Marine Corps Base Hawaii** – Host Site, Onshore Installation
- **PACDIV** – On-site Coordination, Technical Support, Environmental Lead
- **Ocean Power Technologies, Inc**. – System Developer
- **Pacific Shipyards, Inc**. – Buoy & Anchor Fabricator
- **Sea Engineering Inc.** – Ocean Engineering Contractor
- **MK Engineers, Ltd**. – Electrical Engineering Contractor
- **Belt Collins Hawaii** – Environmental Contractor

Benefits of Wave Power

- Portable source of renewable, non-polluting energy
- Potentially significant savings to the Navy/Marine Corps facility operational costs.
- Complements Federal energy policy to reduce the nation's dependence on foreign oil.
- Energy Security
- Complies with Presidential Executive Order No. 13123 that emphasizes development of renewable power resources at Federal installations.

Why Hawaii?



Wave Energy Levels (kW/m of Wave Front)

PowerBuoy™

Cylindrical, Steel Buoy

- Diameter - 4.5 to 5 meters.
- Length – 12 to 20 meters.
- Mass – 35 to 55 tons.

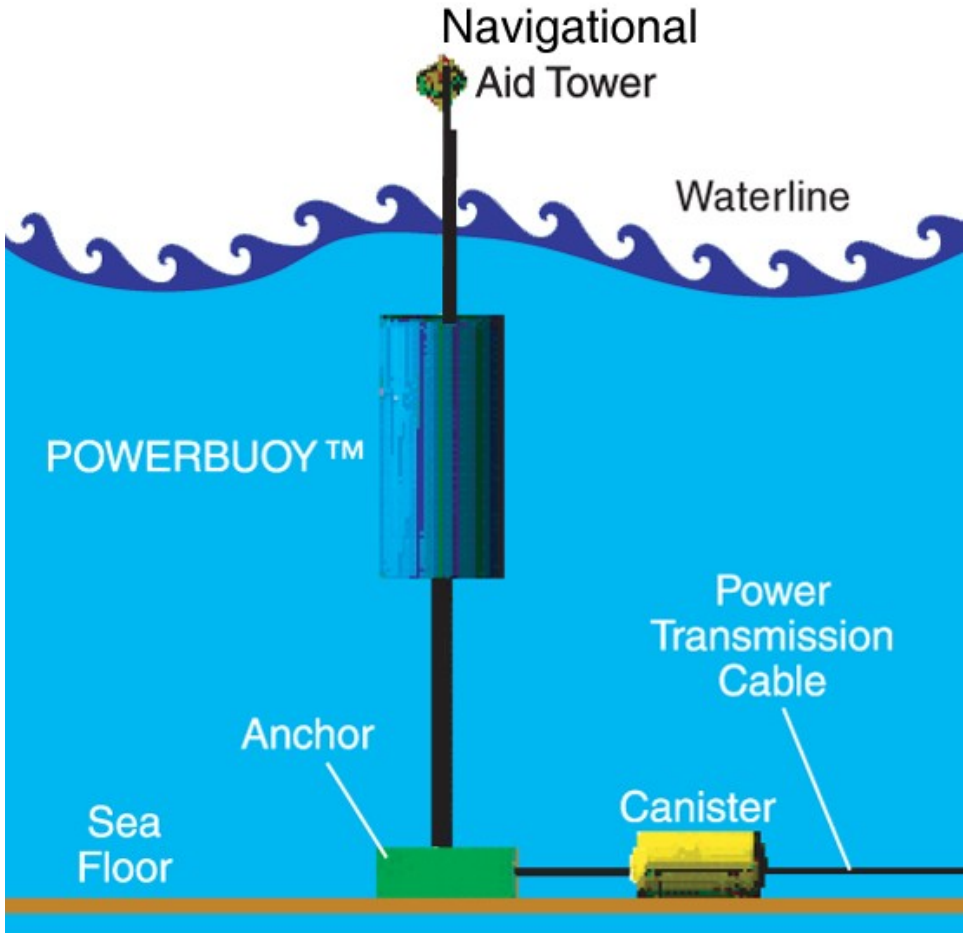
Operates 1.0 - 4.0 meters below surface.

Average System Output: 20 kW

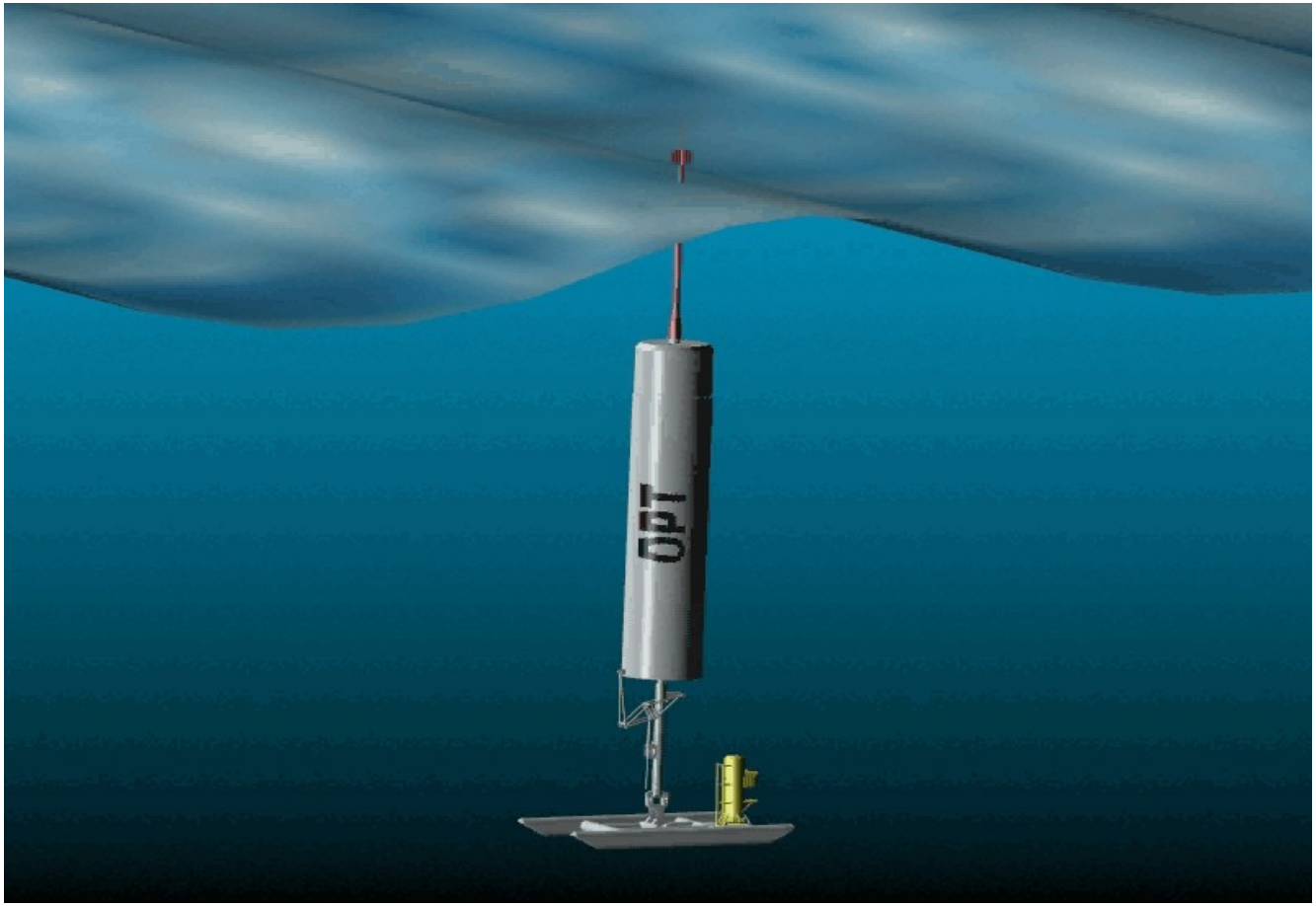
Peak System Output: 45-50 kW

Mooring:

- Rigid spar buoy with universal joint at base.
- Deadweight anchor rock bolted into the substrate provides up to 100-ton holding force.



PowerBuoy™ In Motion



Anchor Installation

WET Objectives

- Develop and Validate Technology
- Demonstrate reliability and cost effectiveness
- Demonstrate feasibility of combining power from a multi-buoy array

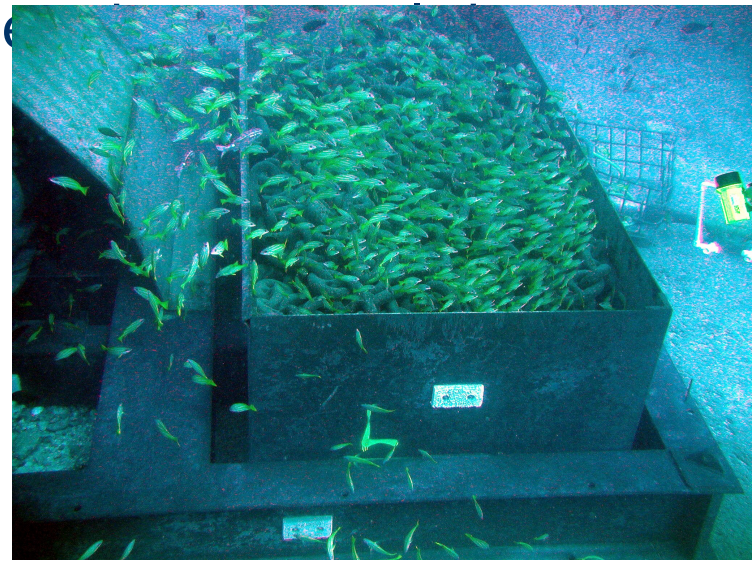
Needs of the US Navy

- Low-cost, efficient, and readily deployable electric power at Naval installations
- Alternative to fossil fuels
  - Reduce cost of facility ownership
  - Improve installation autonomy and survivability during conflicts

Subsea cable installation

Environmental Advantages

- No fuel
  - –Absence of CO_2 emissions, radiation, and particulate matter
  - –No waste or disposal requirements
  - –No danger of spillage or other e
- No negative impact on marine
  - – can encourage growth
- Live coral areas avoided
- Minimal aesthetic impact
- No noise pollution
- No visual pollution



Anchor Box

Environmental Advantages

- Environmentally conscious anti-fouling paints
- Reduces shoreline erosion
- Low noise generation
- High duty cycle (availability)
- Simple, modular construction
- Low maintenance
- Renewable, non-polluting

USS Honolulu and a very curious polar bear

Environmental Documentation

- Environmental Assessment completed and FONSI signed
- Consulted with Government Agencies
  - US Army Corps of Engineers (ACOE)
  - National Marine Fisheries
  - US Fish and Wildlife Service
  - State Historical Preservation Officer
  - State Department of Business, Economic, Development, and Tourism
- ACOE Permit Issued

Environmental Issues Addressed

- Aquatic Biological Resources
  - –Alien Invasive Species
  - –Entanglement
  - –Entrapment
  - –Electromagnetic Radiation (EMI
  - –Electrical leakage
  - –Heat generation and release
  - –Noise
- Terrestrial Biological Resources
- Land and Marine Use Compatibility

Diver Working on Plate Installation for Biological Monitoring

Environmental Issues Addressed

- Historic Preservation
  - –Use of structure eligible for listing in National Register of Historic Places
- Cultural Resources
  - –Ancient Hawaiian Burial Grour
- Shoreline Conditions
- Oceanographic Conditions
- Infrastructure Impacts
- Recreation Impacts
- Public Safety

Cable and Vault Located Above Ground

Program Status

- EA complete and FONSI signed by CNO and MCBH
- Hawaiian Blessing Held
- Anchor Installed
- Subsea Cable Installed
- Bunker Upgrades and Repairs Complete
- First Buoy currently being manufactured
- Installation of First Buoy
  - –April/May 2004
- Start Design of Second Buoy
  - –April 2004

Hawaiian Blessing of Site

Questions

Subsea Cable Installation